PATENT SPECIFICATION

DRAWINGS ATTACHED

839,872

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International Classification:—F07f.

COMPLETE SPECIFICATION

Improvements in or relating to Hollow Explosive Charges

We, SOCIÉTÉ DE PROSPECTION ÉLECTRIQUE PROCÉDÉS SCHLUMBERGER, of 42, rue Saint-Dominique, Paris VIIe, France, a Body-Corporate organised under the laws of the French Republic, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:

The invention has for its object improvements in shaped explosive charges adapted to produce in different materials a cracking or breaking effect which may follow in certain cases perforating effects. The invention is applicable chiefly to hollow charges used for boring, in particular when it is desired to perforate the tubes lining the inner walls of oil bore holes together with the cement mass injected outside said wall and it is also applicable for the cracking of said cement mass and of the geological strata lying behind said cement. It is applicable also to the charges used for breaking blocks i.e. for cracking and breaking stone blocks in quarries.

The invention has also for its object to increase the efficiency of said hollow charges by increasing the cracking and breaking effects produced thereby.

It has also for its object, in the case where the hollow charges are used for perforation, like when perforating the tubings lining the inner walls of oil bore holes, to allow the cleaning of the perforated holes which otherwise might get choked entirely or partially with junk of any kind.

To this end, the invention consists in providing between the actual explosive charge and the recess which characterizes the shaped or hollow charge a substance consisting of titanium, zirconium or hafnium or a mixture or alloy of said substances or a mixture of aluminium and ferric oxide. In practice, this result may be obtained by coating the usual cover, whether of metal or otherwise, which generally separates the explosive from the free space in the recess of the charge with a layer of titanium, zirconium or hafnium or a mixture of such metals, or a mixture of aluminium and ferric oxide. Said layer may be arranged either on the whole surface of the cover, or on part of the surface in the shape of a ring or separated elements.

Said layer may furthermore be arranged either on the front surface of the cover facing the recess or on the rear surface thereof facing the explosive, or again on both surfaces. Said layer may also be obtained by forming the actual cover by such a substance or mixture of substances of the type defined hereinabove.

It has been found as a matter of fact that when such charges have been used, they have a much higher breaking action than that of conventional hollow charges, said action affecting the material which has been previously perforated by the charge by reason of the fact that the exothermic reaction progresses only inside the mass of material which is to be cracked. Such cracking and breaking effects are not obtained when using conventional charges.

As mentioned hereinabove, the invention is applicable in particular to shaped charges which serve for perforating the tubes lining the side walls of sounding wells together with the cement lying behind said tubes, said charges being used at the level of the oil-carrying strata with a view chiefly to working said strata. With conventional shaped charges, the perforating jet passes generally in a suitable manner through the tube system and the cement but the cracks obtained in the cement are generally insufficient and consequently the fluid lying inside the oil-containing strata behind the cement can flow through the cracks and perforations only with a very small output.

With shaped charges according to the

invention, it is possible to obtain in the cement masses and in the adjacent strata of the ground, large cracks which remain open as mentioned hereinabove and through which the fluid may flow out until it reaches the perforations in the tubes and this obviously increases to a considerable extent the throughput of fluid passing out of said perforations.

Various embodiments of said invention have been shown diagrammatically on the accompanying drawings.

Fig. 1 is a transversal diagrammatic section of a shaped charge according to a first embodiment of said invention.

Figures 2, 3, 4, 5 and 6, show in the same way other embodiments of the shaped charge shown on Fig. 1,

and Fig. 7 shows a shaped charge of any one of the types shown on the previous figures, set into a device intended to perforate the casing lining the inner walls of oil bore holes together with the strata lying behind this casing.

Lastly, Fig. 8 shows another embodiment of the invention.

On Fig. 1, 1 denotes the case of the shaped charge comprising a chamber 2 containing the explosive to be primed by a priming device of any suitable type 3 set for instance at the rear part of the charge. In front of the explosive is shown a conical cavity 4 separated from the explosive load 2 by a liner 5 which according to the invention is made of titanium, zirconium or hafnium or a mixture or alloy thereof, or of a mixture of aluminium and ferric oxide.

In the embodiment of Fig. 2, the conical liner 5 is made of copper or of any other "neutral" substance, but this liner is coated on the side of the cavity with a coating 6 of titanium or other substances abovementioned, the thickness of said coating may be approximately 1 mm.

The charge shown in Fig. 3 differs from that shown on Fig. 2 only in that the coating 6' intended to create the exothermic reaction is not located on the side of the cavity but behind the liner 5.

The device shown on Fig. 4 is the same as that of Fig. 2, but with the difference that the coating 6' instead of being laid over the whole surface of the liner 5 is laid in such a manner as to form the truncated cone ring 7.

On Fig. 5, a corresponding ring 7' is set behind liner 5.

Last, on Fig. 6 the ring of the two previous figures is replaced by dots evenly distributed over the surface of the liner.

All the shaped charge devices shown on the previous figures can be used either directly as block breakers or for perforating the tubing lining the inner walls of the oil bore holes.

Fig. 7 shows such a charge of one of the hereinabove forms set into an apparatus for making this perforation.

On this Fig. 7, 8 denotes a cylindrical hollow extended body inside which are located, the one above the other, a plurality of shaped charges for perforating the casing 9 lining the inner walls of the oil bore holes and the cement run between this casing and the walls. The drawing shows only a section of such an apparatus at the level of one of the shaped charges. It is understood that the apparatus can preferably hold a series of shaped charges placed one above the other. 1 denotes the shaped charge case, 2 the priming device made of a length of primacord connecting together all the charges of the same apparatus, 3 the explosive contained in the shaped charge, and 5 the liner set in the forward cavity. The whole shaped charge assembly is introduced laterally through an opening in the forward wall of the cylinder 3 and is retained in place by a plug 10 screwed in the said opening, the case 1 bearing on the front edge of the opening on the one hand and in a recess 11 hollowed in the rear wall of the body 8 on the other hand. The plug 10 is intended to be perforated in its centre by the jet.

According to the invention, the liner 5 is made of or coated entirely or partly with a substance or mixture of substances as abovementioned.

Experiments have shown that the use of such a shaped charge in this particular case not only allows to obtain a better splitting of the cement and of the geologic strata lying behind the casing 9, but to obtain a "cleaning" of the bore hole which otherwise fills up with junk of all kinds and with the device according to the present invention remains clean and free of junk, which of course increases, the output of the fluid from the formations.

The embodiment of Fig. 8 shows a shaped charge fitted with one of the devices described in Figs. 1 to 6 but assembled in a well known manner into a housing 1 fitted with a stopper 12, the assembly constituting a complete element resistant to pressure and able as such to be freely lowered down a bore hole without being placed inside a tube such as casing 8 of the previous figure, several of these elements being fitted in a well known manner one above the other inside the bore hole. Such a charge can without modification be used otherwise as a block breaker. According to the invention, the liner 5 can as in the previous case be made according to any one of the ways indicated in Figs. 1 to 6.

WHAT WE CLAIM IS:—

1. Improvements in shaped explosive charges adapted to produce in different materials a cracking or breaking effect which may follow in certain cases perforating

effects, consisting in providing between the actual explosive charge and the recess which characterizes the shaped or hollow charge a substance consisting of titanium, zirconium or hafnium or a mixture or alloy of said substances or a mixture of aluminium and ferric oxide.

2. Shaped charge according to Claim 1, wherein the liner itself is made of the said substance or mixture of substances.

3. Shaped charge according to Claim 1, wherein the liner is coated with the said substance or mixture of substances.

4. Shaped charge according to Claims 1 and 3, wherein said coating is placed in front of the liner.

5. Shaped charge according to Claims 1 and 3, wherein said coating is placed at the rear of the liner.

6. Shaped charge according to Claims 1 and 3, wherein the whole surface of the liner is coated.

7. Shaped charge according to Claims 1 and 3, wherein the coating is applied only to part of the surface of the liner.

8. A hollow explosive charge constructed, arranged and adapted to operate substantially as herein described and with reference to any of the accompanying drawings.

H. A. L. VENNER,
Chartered Patent Agent,
1, Great James Street,
Bedford Row,
London, W.C.1.
Agent for the Applicants.

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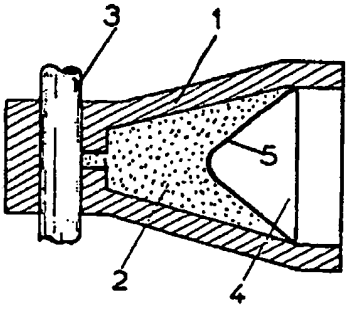

FIG. 1

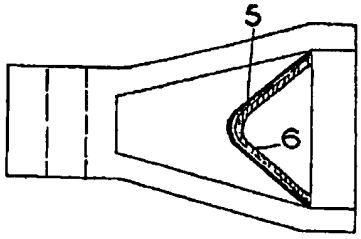

FIG. 2

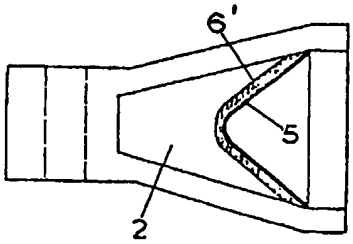

FIG. 3

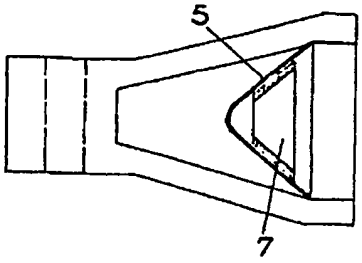

FIG. 4

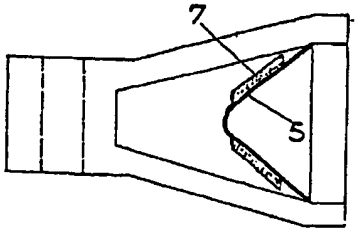

FIG. 5

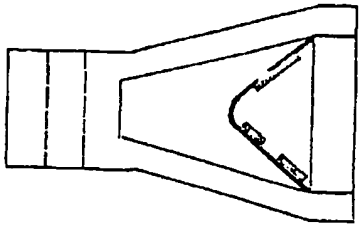

FIG. 6

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

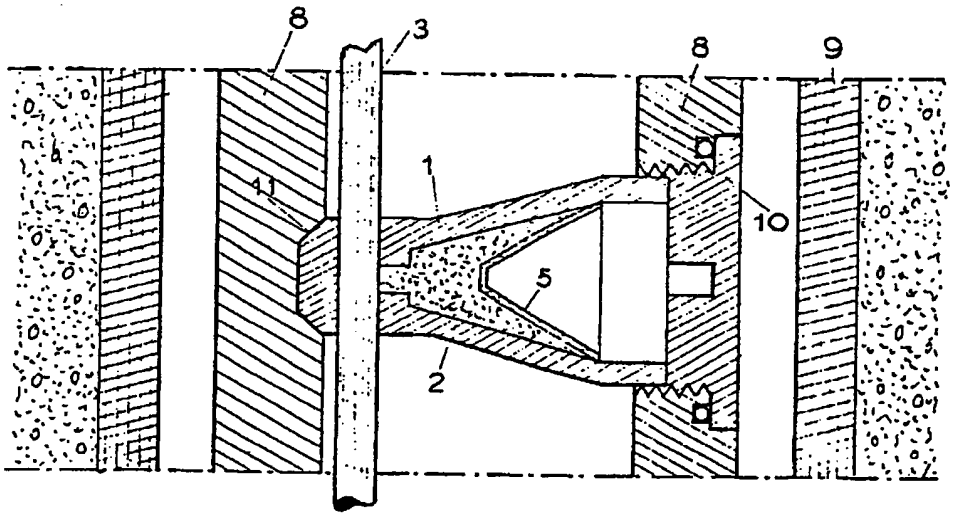


FIG. 7

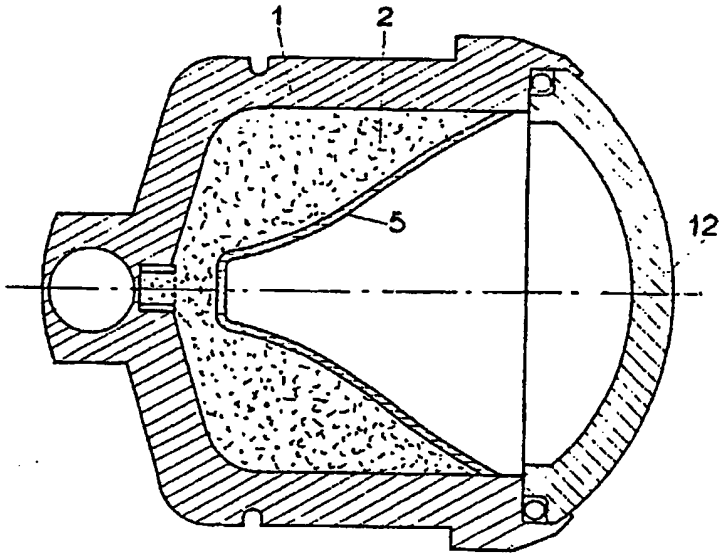


FIG. 8

839872 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

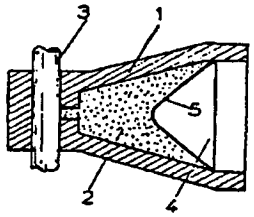


FIG. 1

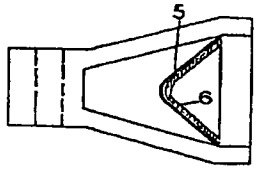


FIG. 2

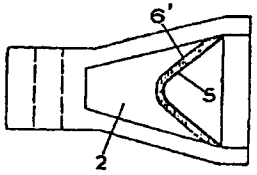


FIG. 3

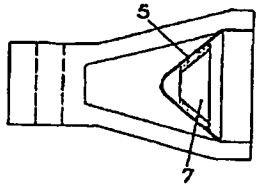
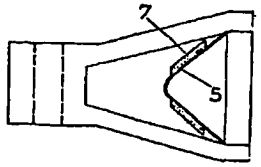
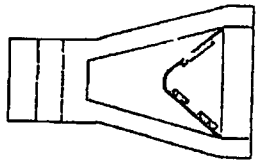


FIG. 4





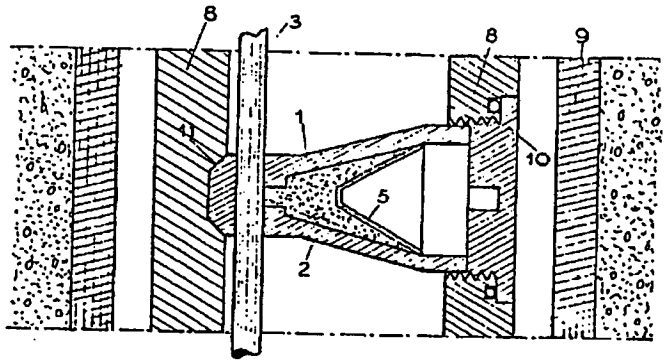


FIG. 7

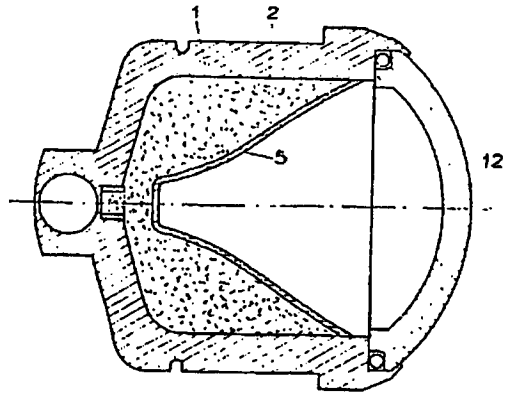


FIG. 8